§3. Measurement of K_α Lines Emitted from Metallic Impurities by Using Pulse Height Analyzer

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X-ray pulse height analyzer (PHA) with a rapid scanning system has been constructed to measure radial profiles of electron temperature and K_α lines emitted from metallic impurity.[1] Si(Li) detectors are used for the measurement of the x-ray region higher than 800 eV. The energy resolution of the detectors has been adjusted to 170 eV at 6.5 keV.

The radial scanning system consists of 4 movable circular slits, and can modulate and identifies the sight lines of the PHA along a major radial direction of Large Helical Device (LHD) in a time interval of a few hundred msec. As a result, the data are successfully obtained with a spatial resolution of a few millimeters.

The radial profiles of K_α lines of metallic impurities such as titanium, chromium and iron have been measured by the PHA system. The energy shift of K_α line is also observed for each radial viewing chord.

Figure 1 shows typical radial profiles of K_α lines of metallic impurities. The electron temperature profile estimated from continuous spectrum is also indicated. During the scanning, the time evolution of electron temperature, the electron density, and the intensity of K_α lines have been confirmed to be approximately constant by another PHA system.

Figure 2 shows K_α line spectra observed through two different positions of sight line as is shown in the figure. In comparison with the two spectra it is remarkably indicated that there is a shift between K_α lines of iron.

The photon energy is different between K_α lines emitted from respective ion charge state. It reflects increase of lower charge state at the position of $\rho = -0.54$ that the observed line shifts to lower energy than at the position of $\rho = 0.00$.

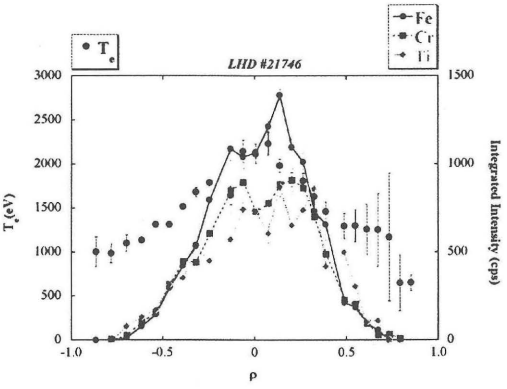

Fig.1. Radial profiles of electron temperature and K_α lines emitted from metallic impurity of iron, chromium, and titanium, respectively. Each point for impurity lines represents the line integral along the sightline with an accumulation time of 240 msec, while the horizontal axis means the position of sightline.

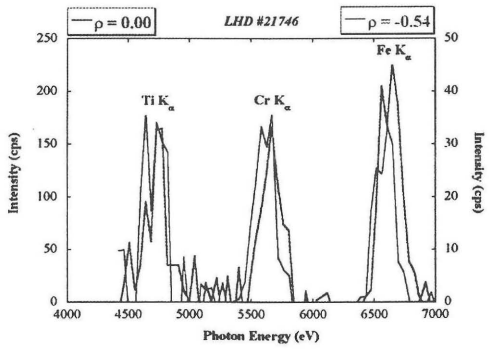

Fig.2. The K_α line spectra of titanium, chromium, and iron. The vertical axis indicates the intensity which is line integral along respective sightline. The scale of each vertical axis are different between the two positions of sight line. The intensity of continuous spectrum is subtracted.

Reference

1) Muto,S., *et al.*,Rev.Sci.Instrum. **72** (2001) 1206-1209